

Newsletter of  
the Materials  
Physics and  
Applications  
Division

## Chuck Swenson's High-wire act

By Karen E. Kippen  
MPA Material Matters Editor

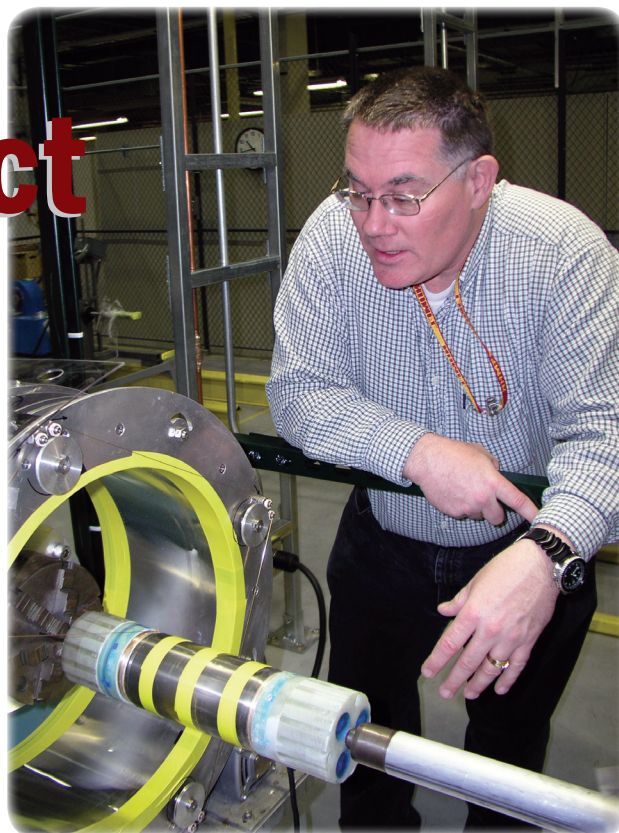
**D**esigning a magnet with the energy density of a rocket engine and the ability to withstand strain greater than one percent might seem like walking a tightrope.

But Chuck Swenson, pulsed magnet program leader at Los Alamos' National High Magnetic Field Laboratory, prefers to think of what he does as traversing bridges—solid bridges between the disciplines of physics and engineering.

"There has to be a balance and a willingness to cross disciplines when designing these machines," said Swenson, who came to the Laboratory last summer to establish a team focused on designing high field pulsed magnets. "The opportunity to do that is really kind of fun."

For example, one day Swenson said he gets "to work on probability theory to interpret fatigue life data, which is a bit technical." The next, he's working with his team members who are confronting the very practical issue of acquiring the right kind of fasteners, without which "nothing is going to work."

Swenson and his team, which includes James Michel, Darrell Roybal, and Ernie Serna, are well underway in the formation of a pulsed magnet production facility. Already they are constructing the next high field user magnet—around 75 tesla—based on lessons learned from the 80T pulsed-magnet prototype, which was tested to its limits last summer. A tesla is a unit of magnetic



**Swenson inspects a fiber winder in preparation for assembly of a magnet's outer coil.**

field strength. The powerful magnets used in Magnetic Resonance Imaging (MRI) machines range from one-half to two tesla.

### Los Alamos calling

Swenson, an Ohio native, earned his doctorate in physics from Texas A&M in 1992. Prior to working at Los Alamos he was director of applied and clinical research at American BioMed in Houston, a senior engineer in Westinghouse's magnet systems division,

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## MPA newsmaker

### Park named Outstanding Young Researcher by Korean physicists' association



Tuson Park, an Oppenheimer Postdoctoral Fellow in MPA-10, has been selected for the 2007 Outstanding Young Researcher Award by the Association of Korean Physicists in America. Park is being recognized for his contributions to the field of correlated electron physics.

Park, who joined the Laboratory in 2003, has a doctorate in physics from the University of Illinois at Urbana-Champaign.

The OYRA award ceremony will take place at a joint reception with the APS Forum of International Physics and other expatriate physicists associations at the APS March meeting in Denver. AKPA was launched in 1979 to promote scientific research in physics and to strengthen ties among Korean physicists in America.

## From John's desk

# Materials Physics and Applications: Focusing on long-term strategic objectives

In this month's "From the Desk," I'd like to first mention two events you'll read about elsewhere in February's *Materials Matters* and then close with a few thoughts on long-term planning.

We had our first MPA All-Hands Meeting last month. For those of you who attended, I hope you found it a good use of your time. If not, I'd very much like to hear what you would have rather heard instead—various feedback channels are available to you, including directly to me, through your group leader, or anonymously, if needed.

One of the themes I tried to articulate in our All-Hands was not just "what" we do, but also "why" we do it. Especially when there are a number of short-term distractions, keeping our eyes on our long-term strategic objectives is very important. These objectives, which span our weapons, threat reduction, and science programs customers, emphasize leveraging our most valuable assets—all of you—to deliver transformational breakthroughs for national security challenges and to advance the frontiers of science and technology.

Another event you'll notice in this month's issue, despite my best efforts to cover it up, is the fact that I recently had a birthday. I appreciate the many kind notes that I received. On such occasions, it's inevitable that one is a little self-reflective. In addition to being my birthday, it's also the 10-year anniversary of my coming back to the Lab—having started at Los Alamos as a graduate student and having left as a post-doc. The Lab has certainly evolved in the past decade. I think

that it's hard to imagine that we could have created an MPA Division 10 years ago, whereas in our current structure we are a technically vibrant and well-funded organization thanks to all of your contributions. Most recently this was validated by the President's FY08 budget. Although there are some issues for the Lab and for us locally to watch as this budget works its way through Congress, on average the future for MPA continues to look bright.

Finally, I'd like to mention several longer-term planning efforts that are consuming a good fraction of my and your group leaders' time. We are currently in the midst of LDRD proposal season. I'm gratified by the wide range of interesting and compelling proposal ideas that I've seen so far. While this makes the process of developing our divisional endorsement strategy very difficult, it is also a good indication of the technical health of the organization.

As you should recall, the Grand Challenge Workshops (in which a number of you participated in the fall) are playing a key role in defining our institutional science strategy, including and beyond LDRD. The next step in these planning efforts was recently announced



by Terry Wallace: a process to define our future "signature facility," and this will include a number of planning workshops.

Today, LANSCE is our signature facility—much of the science we do and the people who do it have strong connections with LANSCE, and LANSCE also plays a dominant role in defining our science face to the outside world. As a Laboratory, we remain solidly committed to LANSCE for the next decade and beyond (and we've recently committed to a major refurbishment program that will extend LANSCE's useful life for another decade or two). However, we are also beginning to plan for what comes next (which very well may continue to include LANSCE).

There's strong recognition within senior management that this should be a materials facility, and from my perspective, it seems likely that our vision will be a "signature capability," a collection of resources (people, tools, and facilities) rather than a monolithic single facility.

I would very much welcome your engagement in defining what a materials signature capability might look like. From my perspective, it should include an integrated competency in "making stuff," "measuring stuff," and "modeling stuff;" however, this vision is far from complete, and defining it appropriately will shape our materials strategy for decades to come. I welcome hearing your perspectives on what our signature facility (or capability) should be.

—*Materials Physics and Applications*  
Division Leader John Sarrao

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[www.lanl.gov/orgs/mpa/materialmatters.shtml](http://www.lanl.gov/orgs/mpa/materialmatters.shtml)



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## Celebrating service



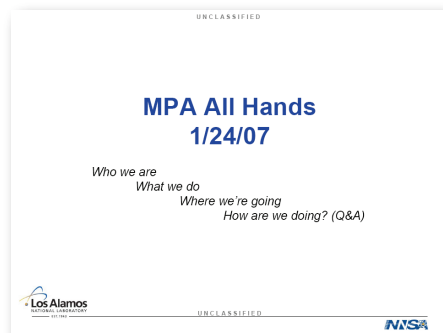
**Congratulations to MPA employee  
Rangachary Mukundan, MPA-11,  
celebrating his 10-year service anniversary.**

## Division's present and future focus of first MPA All-Hands Meeting

MPA's strategic direction was the focus of the first MPA Division All-Hands Meeting, held recently in the Physics Auditorium.

Staff from throughout MPA gathered to hear Division Leader John Sarrao elaborate on the division's enabling role in the discovery of new science and the development of new technologies that solve critical national security challenges.

Describing MPA's strategic focus relating to the weapons program, threat reduction initiatives, the Science Program Office, and LDRD, he stressed the impor-



tance of portfolio management, building on the division's strengths and leadership; leveraging capabilities across sponsors,

and teaming for success.

He also highlighted the programs that enable these successes—recognizing and publicizing achievements through MPA's communication strategy, supporting professional development through its mentoring program, and examining the “intellectual environment” through an upcoming Leadership Development Survey.

Other topics covered included overviews of the Division's budget and personnel profile, recent areas of growth and opportunity, and group research and technical accomplishments.

## MPA-11 work is among 2006's most significant fuel cell research



MPA-11's work on reversing the effects of fuel cell cathode and anode poisoning by sulfur species was highlighted, along with four other advances by collaborating laboratories, universities and industry, as the most significant fuel cell research in 2006 to the Directors of the Freedom Cooperative Automotive Research (FreedomCAR) alliance.

FreedomCAR is a public/private partnership between the U.S. Department of Energy and the U.S. Council for Automotive Research (USCAR), which represents the pre-competitive research and development interests of General Motors, Ford and DaimlerChrysler. The selections were announced at the Director's December meeting in Detroit.

## NMR team heavy fermion superconductor research reveals complex thermodynamic phase

MPA-10's Nuclear Magnetic Resonance Team recently published its work on the heavy fermion superconductor  $\text{CeCoIn}_5$  in *Phys. Rev. Lett.* **98**, 036402 (2007).

Postdoctoral researchers Ben-Li Young, now at National Chiao Tung University, Taiwan, Ricardo Urbano and team lead Nicholas Curro investigated the NMR spectra of  $\text{CeCoIn}_5$  down to 40 mK in magnetic fields up to 12 T.

At these temperatures and fields, this material undergoes a thermodynamic phase transition to a new state of matter. Bulk measurements have suggested that this phase is a new inhomogeneous superconducting state involving pairing of electrons on Fermi surfaces with unequal volumes.

Such a state has been predicted to exist in certain condensed matter superconductors as well as within the core of neutron stars. The NMR measurements, however, reveal this phase is more complex, consisting of coexisting local moment magnetism and superconductivity.

These results may provide clues for understanding the unusual normal state properties of this material and call for new theoretical investigations of the interplay of Kondo interactions, magnetism, and unconventional superconductivity.

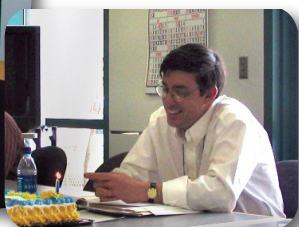
Authors of “Microscopic Evidence for Field-Induced Magnetism in  $\text{CeCoIn}_5$ ,” also include MPA-10's Joe Thompson; MPA-DO's John Sarrao; A. B. Vorontsov, Louisiana State University; and Matthias Graf, T-11.

An LDRD-ER funded this work.



### Happy Birthday John!

MPA-DO staff Melinda Naranjo (at left in center) and Susie Duran (at left, right) recently surprised Division Leader John Sarrao with a birthday cake, presented to him at a recent MPA Council Meeting (below).



# HeadsUP, MPA!



## United States citizenship and immigration status

If you host, escort, or otherwise interact with foreign nationals in the course of your work, not only must you be aware of export control issues, you must also understand the basic terminology pertaining to immigration and citizenship. Awareness of the distinction between a permanent resident and a U.S. citizen will help you determine your escorting responsibilities, for example, which in turn could help you avoid a security incident.

To read more, see the Security Smart found at <http://int.lanl.gov/security/news/archive.shtml>.

## Winter driving

Winter driving is the focus of a new Safety Short that covers how to prepare your auto, how to plan ahead once the snow and ice arrive, and how to control your car after the inclement weather has arrived. For more details, see the publication at <http://int.lanl.gov/safety/safetyshort/>.



## Not all emails are created equally!

How many emails do you send each day? Although email is a very quick and efficient way of communicating with

colleagues, you must exercise some caution.

Information you transmit could possibly contain classified or unclassified controlled information.

It is your responsibility to ensure that email containing classified information is NOT transmitted over unclassified email channels.

A new Security Smart is available to remind you to carefully review the content of your email before hitting send. To read the publication, see <http://int.lanl.gov/security/documents/index.shtml#security-smarts>. If you have any questions, the Security Help Desk is available at 5-2002 or [security@lanl.gov](mailto:security@lanl.gov).

## Close that door

A new Security Smart reminds employees about the importance of ensuring doors and gates requiring access authorization are secured at all times.

It only takes a couple of seconds to ensure the door or gate you have just entered closes properly. Do your part to aid in securing Laboratory facilities.

To read about preventing unauthorized access, key responsibilities, and a list of resources, see the Security Smart at [http://int.lanl.gov/security/documents/security-smart/close\\_door0107.pdf](http://int.lanl.gov/security/documents/security-smart/close_door0107.pdf).

*Heads UP, MPA! reports on environment, safety, and health, security, and facility-related news and information.*

## STC contributes strong leadership to HTS Wire Development, Applications Workshop

The STC contributed strong leadership to the DOE's Office of Electricity High-temperature Superconducting Wire Development and Applications Workshop held recently in Panama City, Florida. The workshop serves as the primary technical forum for OE's High Temperature Superconductor program, addressing technical progress, issues, and barriers. OE is a primary sponsor for the STC through the HTS program.

STC Deputy Center Leader Ken Marken, and MPA-STC's Steve Ashworth served on the organizing committee for the workshop and also served as chairmen for two of the sessions. In a key presentation Marken summarized ongoing STC contributions to the OE HTS program. STC Center Leader Dean Peterson spoke on the status of the Japanese development effort. MPA Division Leader John Sarrao co-chaired a session on collaborative efforts between OE and Basic Energy Sciences, and also presented the keynote talk in that session. MPA-STC's Leonardo Civale provided a key presentation on flux pinning research in the Basic Energy Sciences session and Jonathan Storer presented significant progress on the STC's research on co-evaporation deposition of YBCO superconductors.

## AFNWCA briefing highlights recent work by MST, MPA

Recent work by MST and MPA personnel was highlighted at a briefing to the Air Force Nuclear Weapons and Counterproliferation Agency.

The work is being conducted as part of the Enhanced Surveillance Campaign and involves developing lifetime models for canned subassemblies of nuclear weapons.

The latest advances to the model com-

bine scientific results with engineering data to provide new insight into material aging effects.

Team members include Jennifer Lillard, Lily Wang, Joel Katz, Kathy Lao, and Richard Weinberg, MST-6; Jon Rau, Clay Macomber, and Tom Jachimowski, MPA-MC; and Michael Janicke, C-IIAC.

## Got news?

*MPA Material Matters* features technical highlights developed each week for the Director's Office.

If you have unclassified news you'd like to see featured, please send it to your group leader to be forwarded to *MPA Material Matters* Editor Karen Kippen.

## Los Alamos conducts Advanced Fuel Cell Workshop for Army Research Office

Los Alamos National Laboratory hosted the Army Research Office-sponsored Alkaline Membrane Fuel Cell Workshop, in December in Phoenix. The workshop was the first of its kind in this area and brought together 62 national and international experts in the areas of fuel cells, polymer electrolytes, and catalysis.

Alkaline membrane fuel cells are in many ways similar to the more traditional, acidic polymer electrolyte fuel cells, but offer significant advantages in electro-catalysis, in large part due to increased materials stability in base rather than

acidic media. Alkaline membrane fuel cells offer high performance without the use of expensive catalysts like platinum and the ability to directly and, in some cases, completely electro-oxidize fuels containing carbon-carbon bonds, such as ethanol. Unfortunately the current membranes employed in these systems lack the chemical stability and ionic conductivity necessary to make high performance devices, primarily due to cation instability at high pH.

MPA-11's Bryan Pivovar organized and gave the overview talk at the work-

shop, and James Boncella, MPA-MC, and Lawrence Pratt, T-12, gave presentations on cation stability and conductivity from a chemical and theoretical perspective. These three researchers and coworkers Brian Einsla, MPA-11, and Shaji Chempath, T-12, are currently funded on a BES program to investigate advanced cations and cation interactions to develop next generation materials.

A report from the workshop's findings was to be presented to the Army Research Office in late January in order to help guide future research programs.

## Hecker named co-director of Stanford's Center for International Security and Cooperation

Los Alamos Director Emeritus Siegfried Hecker, MST-DO, was recently appointed co-director of the Center for International Security and Cooperation, in the Freeman Spogli Institute for International Studies at Stanford University.

He joins political science professor Scott Sagan in leading the center, which draws from a range of disciplines to focus on current problems in international security.

Hecker, who since 2005 has been a visiting professor at CISAC, also assumed positions as a research professor in the Stanford School of Engineering's Department of Management Science and Engineering and a senior fellow at FSI.

Hecker's "scientific achievements as a metallurgist, his leadership and talent as the head of a renowned U.S. Department of Energy laboratory and his decades-long dedication to improving global security

make him an extraordinary choice to help direct CISAC in the years ahead," FSI Director Coit D. Blacker said, announcing the appointment.

In 1992 as Los Alamos National Laboratory Director, Hecker made an historic trip to Sarov, the Russian weapons laboratory, just weeks after the dissolution of the communist empire.

Since then he has fostered U.S. cooperation with Russian nuclear laboratories to secure the vast stockpile of former Soviet nuclear weapons and materials. Since 2004 he has traveled with CISAC founder John Lewis to the Democratic People's Republic of Korea three times, gaining rare access to and expertise on North Korea's nuclear weapons program.



Siegfried Hecker

## Symposium on in situ characterization of film growth organized by MPA-STC's Matias

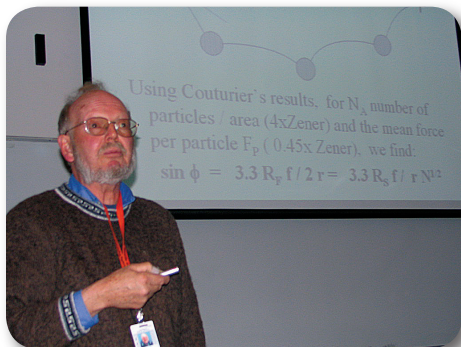
MPA-STC's Vladimir Matias organized a symposium on "Advances in In Situ Characterization of Film Growth and Interface Processes" at the Materials Research Society's 2006 Fall Meeting in Boston.

The symposium covered research on studies of film growth and interface processes with a focus on recent advances in situ characterization techniques. In situ techniques that were covered in the symposium included ion scattering and mass spectrometry, electron microscopy, reflection high energy electron diffraction (RHEED), scanning probe microscopy, optical monitoring (e.g. spectroscopic ellipsometry and emission spectroscopy) and in situ x-ray analysis.

The symposium was kicked off with a tutorial covering in situ RHEED, synchrotron x-ray diffraction, low energy electron microscopy as well as time-of-flight ion scattering and recoil spectroscopy.

There were 74 excellent presentations at the symposium, including 17 invited talks from the United States, Europe, and Asia. Approximately 200 people attended the symposium during the week.

As part of an MRS experiment, PowerPoint presentations as well as "live" audio were captured for this symposium and will be posted on the MRS website for MRS members to view.



Credit: James Gurule, MST-8

**Dr. Roger Doherty at the first Materials Science Seminar, held last month in the MSL Auditorium.**

## Materials Science Seminar Series kick-off draws full house

**Dr. Roger Doherty, the A.W. Grosvenor Professor of Materials Engineering at Drexel University, presented the inaugural materials science seminar last month in the Materials Science Laboratory Auditorium. Doherty's presentation, "The Long-standing Problem of Abnormal Grain Coarsening: The influence of second phase particles and low angle boundaries," drew an attentive audience of Los Alamos scientific and technical staff. MST-8 sponsors the monthly series.**

## “Swenson” *Continued from page 1*

also in Texas, and a research scientist for 12 years at the National High Magnetic Field Laboratory in Tallahassee, Florida.

There Swenson developed components for nuclear magnetic resonance systems, set up a molten metal laboratory, and eventually ventured into pulsed field magnets, which he called “interesting beasts.” His last five years were spent as the head of pulse magnet programs there.

As a frequent visitor to Los Alamos, Swenson was keenly aware of the innovative work being done at the NHMFL’s pulsed field facility, the diversity of its user community, and the strength of the Laboratory’s materials science capability—features which eventually drew him here. “The ability to tap into discussions, collaborations, and seminars, to the bigger-broader picture, as well as the resources of the DOE integrated complex is very intriguing,” he said.

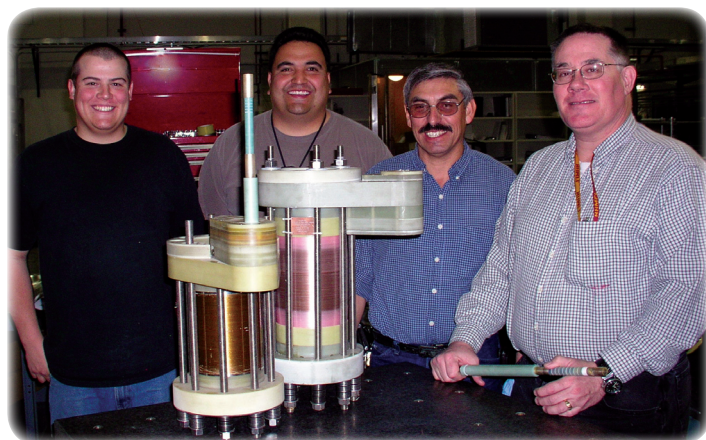
In return, scientists at the Los Alamos magnet laboratory can immediately call upon Swenson’s expertise as he walks the floor, talking to the magnet users and looking for ways to improve their experience.

“Chuck understands how to design magnets, but he also wants to make them better, stronger, and more reliable,” said Alex Lacerda, director of the Pulsed Field Facility. Lacerda cited bringing the magnet designer to Los Alamos as one of the year’s greatest accomplishments. Swenson is “one of the world leaders in pulsed magnet design and fabrication...well known worldwide in the pulsed magnet community,” Lacerda said. “And with a PhD in physics he is not only extremely well qualified to design these...things, but he understands the materials properties in a broad way.”

### Finding a new balance

With his extensive experience in magnet manufacturing, Swenson is willing to innovate but also has the discipline required to make the decisions and compromises required in designing complex magnet systems.

AET-1’s Jim Sims collaborated with Swenson in designing and engineering the recently commissioned 100T multi-shot



From left, James Michel, Darrell Roybal, Ernie Serna, and Chuck Swenson in the Pulsed Magnet Production Facility.

magnet. He said Swenson likes to try new designs, but “what he does try typically has a sound theoretical basis and/or empirical justification. Further he understands the need to build prototypes and the fact that when you’re working at the limits of materials and of our understanding...things will fail.” Sims described their collaboration as a “comfortable, but intellectually challenging experience—we are solving very difficult technical problems.”

The 100T magnet is capable of the highest magnetic fields ever produced nondestructively on a repetitive basis. To create the magnet’s insert technology, which is a type of short-pulse high field magnet, Swenson developed a thorough physical understanding of how these magnets worked.

According to Sims, Swenson conducted and documented extensive investigations of the materials and fabrication methods used, as well as of the magnet failures that occurred. “This work permitted reliable, short-pulse, high field user magnet technology to move beyond the 60T field levels where it had been ‘stalled’ for years,” Sims said, and the new understanding and technology developed “has been critical in achieving the present accomplishments.”

### Drawn to discovery

“We’re producing the highest fields in the world right now,” Swenson said, referring to the series of world records for nondestructive pulsed-magnet performance set this summer at the NHMFL pulsed field facility. “We’re supporting the research and development and materials science that drive these systems.”

The reward is the discovery that comes from such endeavors. For example, with the 100T, after 10 years of research, instrument development and construction, researchers can explore uncharted regimes of low temperature and high magnetic field, central to understanding the mechanism of superconductivity, magnetic field-induced phase transitions, and so-called quantum critical points, in which small changes in materials properties at very low temperature have dramatic effects on physical behavior.

Swenson said he sees his magnets as tools “to enable scientific experimentation and knowledge...that can better inform us about nature.” To play a part in that development and discovery “is why I get up in the morning,” he said. Swenson lives in Los Alamos with his wife and three children.

### My favorite experiment

**What:** Fatigue lifetime studies on Zylon Composites

**When:** 2004

**Where:** NHMFL, Tallahassee

**How:** We manufactured test samples to document the mechanical performance of composites developed for our magnet systems. An evaluation of fatigue lifetime of these composites provided us with a startling result. Organic composites exhibited lifetimes in the 30-90 kilo cycle range while operating at 2% strain and ~ 3.0 - 3.5 GPa engineering stress. This exceeded the performance of any metallic material known.

**The a-ha moment:** I had the realization that organic structural materials can far exceed the performance of most, if not all, metallic systems. The data brought home the reality that polymer chemistry technology implicitly has much more control of the molecular structure than has been achieved by metallurgical processing methods. There is a now profound performance gap between organic and metallic composites systems. The engineering challenge is to develop complementary systems for devices like high-field magnets.